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DEVELOPMENTAL ASPECTS OF PLURAL FORMATION IN ENGLISH

by

© SUSAN J. INNES

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance a thesis entitled 'Developmental Aspects of Plural Formation in English' submitted by Susan J. Innes in partial fulfilment of the requirements for the degree of Master of Science in Psycholinguistics.

ABSTRACT

Plurals of 24 nonsense forms and 8 real words were elicited from 120 subjects aged 2 through 7 years. The nonsense forms represented all of the stem-final consonant phonemes of English and one stem-final vowel. Comparisons with Berko's (1958) data showed a replication effect on shared items, but new data provided by this study challenged some of Berko's conclusions. The correlation of age with performance was low. Reclassification of results into "performance groups" showed that subjects followed an extremely systematic progression in learning. Plurals were apparently not learned on an individual item-by-item basis but by the stepwise incorporation into a rule of a succession of phonetically homogeneous classes of items.

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BACKGROUND

Basis for the study

Linguists are becoming increasingly aware of the need for a body of reliable data on which to base and evaluate theories, and there is a demand for theories which have testable consequences (Natalicio 1969, p.159). Subsequent investigations may then adjust or extend the theories and so a field of knowledge, not purely surmise, may be gradually built up. Within the field of language acquisition there is a serious shortage of reliable data. In many older studies, data were gathered by non-professionals under uncontrolled conditions, frequently from the investigator's own child. Information was often inaccurate, biased, and anecdotal in character. There is a need for basic, controlled research which can supply the foundation for the formulation and testing of hypotheses.

Data collection can be carried out in more or less useful ways. Simply recording all (or a large sample) of a child's verbalization provides a mass of data, but a mass which is cumbersome, haphazard, and not as useful as more carefully gathered data simply limited to one feature of language development. Theoretical considerations, such as the postulation of rule-learning by a speaker, must also influence the manner of data collection.

The notion of rules in language is not new. Paul

noted the creativity of language users (1891, p.97) and Bloomfield discussed regularity of speech forms which allows productivity (1933, pp.274-5). A full discussion can be found in Derwing (1973, pp.308-13).

Cazden (1968) followed the development of three children aged 1 1/2 to 4 years and noted only noun plurals. She did not attempt to elicit plurals but observed when other features of the child's speech required them, and observed the form of the noun used. She discovered a sequence of four stages: (1) the child produces no plural endings; (2) the child produces occasional correct plurals; (3) the child produces more plurals but makes systematic errors; and (4) the child finally controls the plural. The most informative stage here is the third, where the child makes systematic errors in pluralization. Is this reconcilable with the following statement made by a psychologist (unnamed) during the open discussion of a paper concerned with language acquisition (Brown and Fraser, 1964)? He asserted that the plural inflection "is first used in some small percentage of the cases where it is required, and this percentage shows a gradual increase with age. This aspect of development looks more like a gradual increase of habit strength than like the acquisition of a rule."

Cazden's study suggests that not only is there an "increase of habit strength" but that the "habit" is then extended by the child to other nouns. At this point it should no longer be called a habit. The child must be considered

to have learned a rule which he sometimes applies in unsuitable as well as suitable instances. It is from such "errors" that we can gain some insight into the nature of language acquisition. Such errors show us that the child develops a set of rules, frequently changing and being refined, for the production of language. We must be interested in these rules if we are concerned with the development of language in children.

Rather than wading through large quantities of data looking for errors to learn from, it is preferable to set up a test situation to capture the required information. Berko (1958) used nonsense pictures and words in a study of the acquisition of various morphological features. Had she based the test on real words, her results would not have distinguished clearly between individual vocabulary items known to the child (pure memory) and the child's control of a rule for pluralization.

Previous studies

A number of pluralization studies in English have employed the nonsense-word technique. Of major importance are the studies by Berko (1958) and Natalicio (1969), with others by Koziol (1970), Anisfeld and Tucker (1967), Miller and Ervin (1964), and Ervin (1964).

Berko

Berko's 1958 study set out "to discover what is learned by children exposed to English morphology (p. 359)."

She studied the areas of the plural and the two possessives of the noun, third person singular of the verb, progressive and past tense, and the comparative and superlative of the adjective. Children were represented from a Kindergarten and Grade One class. She employed the nonsense-word technique mentioned above. Her test contained 27 straightforward inflectional items plus other question items designed to assess the child's interpretation of the meaning of compounds. There were nine nonsense forms to be pluralized in Berko's test; these were /wəg/, /gəč/,/kæž/, /tor/, /lən/, /niz/, /kra/, /tæs/, /hiyf/, and one real noun, glass (=/glæs/).

Berko found that the Grade One subjects (Ss) did significantly better than the Kindergarten Ss on slightly less than half the inflectional items. She grouped all the children together for discussion of errors and found that /kra/, representing the class of final segments which can be followed by either /s/ or /z/ in English, has significantly more errors than /wəg/, where a following /s/ is phonotactically impossible. She noted that performance is worst on the four sibilant forms, /niz/ receiving the fewest correct pluralizations (28%). There was no improvement from Kindergarten to Grade One on these four items. Berko noted generally that most mistakes were repetitions of the singular form. An exception she mentioned was /hiyf/ - /hiyfəz/, where /f/ appeared to be grouped with the sibilants by four children.

This study clearly raise many questions which it

not answer. Its major drawback was its overambitious diversity of content within one short test; its results are interesting and very suggestive, but are unable to provide much insight into any one area. The age ranges she employed, four to five years and five and one-half to seven years, are very broad and, indeed, she grouped all her Ss together in many cases, giving an effective range of four to seven years. It is unfortunate that the test items were always presented in the same order. It is possible that preceding items affected in some way a following one. Although Berko stated that Ss often repeated the singular form, this was not required of them, and it is thus not certain whether they always perceived the word as the experimenter (E) intended. This is an important consideration, since it is possible for "incorrect" responses to be in fact correct for the stimulus as perceived by the child; e.g., a response /wəgzəz/ to E's /wəg/ could mean either that the child thought the stimulus was /wəgz/ which he pluralized correctly, or that he used an incorrect plural ending, /zəz/.

Natalicio

In a very careful thesis study, Natalicio, also using the nonsense-word technique, investigated pluralization in children of grades one, two, three, and ten. Although she was basically interested in drawing conclusions to aid in second language teaching, her work is also of significance in the development of our knowledge of language acquisition in native English-speaking children. Her study tested and

compared native English speakers and native Spanish speakers who had learned English at about age six.

Her initial study showed that varying the initial consonant in a CVC sequence did not affect the pluralization of that sequence to a significant degree. Having established this, she tested 72 native English speakers, 18 from each grade, and an "item control" group of 12 adults whose responses were used to determine correctness of the children's responses. All Ss were required to repeat the singular form. A segment was deemed to be "under control" by a group of subjects if 15/18 of responses to that item were correct (3/18 being attributable to random error).

Natalicio found a progression from Grade One to Three in control over segments. In Grade One the items ending in /p,t,k,f,b,d,g,v,n,m,l,r,h (= lengthened vowel)/, and /w/ were "under control". In Grade Two, /y/ and /š/ were added to this list, and by Grade Three /ŋ,s,z/ and /č/ were added, with borderline control over /ž,ǰ/ and /ð/. Only /θ/ remained uncontrolled at this point.

However, /θ/ or /ð/, were shown (by the faulty repetition of the singular forms) to be not yet in many S's phonemic repertoires. "Correct responses" were reassessed on the basis of a S's correct response to a singular stimulus ending in /θ/ or /ð/, eliminating those Ss who repeated the stimulus changing /θ/ or /ð/ in some way. The phonemes /θ/ and /ð/ were then restored to a more normal position with the plurals in /s/ and /z/. In the case of /ðz/ plurals,

this adjustment did not improve scores and so it was accepted that this rule is developed later than the others.

Natalicio, like Berko, found that the repetition of the singular form was the most common mistake, rather than the use of a wrong inflection.

Koziol

Koziol (1970) investigated pluralization skills in 24 subjects each from Kindergarten and Grades One, Two and Three, again employing the nonsense word technique. He used a 116-item singular-plural and plural-singular production test, and a 116-item recognition test. His study was carried out to inform teachers of the level of language which children in the early grades have reached. He showed that teachers may not assume fairly complete competence, as they often do. His Kindergarten Ss gave no correct response to an /ðz/ plural nonsense word, and not until Grade Three was there 90% competence. Words ending in /s/ and /z/ were found to be the last types to be controlled. Koziol tested performance on monosyllabic versus polysyllabic words and found there was no significant difference.

Anisfeld and Tucker

Anisfeld and Tucker (1967) examined pluralization from more aspects, including six nonsense-word tests (three production and three recognition) along fairly standard lines, and two preliminary tests of a different nature. All of the subjects were six years old. They concluded from

one preliminary test that children used numbers as a primitive form of pluralization when they had difficulty with the morphological marker. The other preliminary test showed that the subjects worked on a principle of "pluralization by addition", choosing a longer word (bip - bipum) rather than a shorter or identical word to indicate a plural. In their major studies they found that in production there were significantly more errors on /ɔz/ plurals than on /s/ or /z/ plurals. In recognition tests the /z/ plural showed significantly fewer errors. They rationalize this result as being due to its lack of ambiguity; there are very few English noun stems ending in a consonant plus /z/ cluster; noun forms which end in such sequences, therefore, are almost certain to be plurals.

A major problem with Anisfeld and Tucker's work is that they reinforced Ss' correct answers with "good" and responded to incorrect answers with "no", encouraging the Ss to try again. Eventually they even gave the correct response. Bryant and Anisfeld (1969) showed a significant learning effect in such a situation. Their study tested several different aspects; in three production tests, one was singular-plural and plural-singular with pictures, one was singular-plural and plural-singular without pictures, and the third was singular-plural and plural-singular with pictures but the Ss were asked to tell a story about what they saw -- a freer situation. The test without pictures was shown to be more difficult than the others. The

investigators' rationale is not thoroughly explained nor is it entirely clear what they have shown from these differing studies.

Miller and Ervin, Ervin

A few investigators have tested pluralization while studying general language development in children. Miller and Ervin (1964) gave a short plural test of real and nonsense words to children aged one to about three. They found that the plurals for real words appeared first, with the equivalent nonsense words not being pluralized until several months later. Ervin (1964) reports similar findings in 24 two to four year olds tested monthly. She found that sibilants needing a plural were left uninflected at first. She notes that the /ɔz/ form is overgeneralized in the forms /ɔz/, /sɔz/, /zɔz/ for up to two months. These findings are fragmentary but again highly suggestive.

The present study

The present study attempts to cover the range of the acquisition of pluralization by testing for all possible final consonants, and a representative vowel, over a wider age range than has been attempted in any previous study known. Natalicio, who tested all final consonants, started at the Grade One level. No study has tested children younger than Kindergarten age, by which time many plurals have been shown to be well established. The present study was limited to a production test. Anisfeld and Tucker showed

that recognition tests bring other considerations into play. It is felt that recognition skills should be the subject of their own test, allowing the present study to investigate the development of the production of plurals as fully as possible.

CHAPTER TWO

METHOD

Stimuli

The productive class of English nouns is pluralized by suffixing /s/, /z/ or /əz/. Which of these three suffixes is used depends on the final segment of the noun, and may be shown as follows (cf. Berko, 1958, p. 151):

/s/ after /p,t,k,f, θ /

/z/ after /b,d,g,v, ð ,l,m,n, ŋ ,r, l/ or a vowel or glide (/w,y/)

/əz/ after /s,z,š,ž,č,ǰ/

A one-syllable English-sounding nonsense form was constructed for each of these segments, except for vowels. Polysyllabic words were excluded on the basis of Koziol's finding that there is no significant difference in pluralization between monosyllabic and polysyllabic words. In order to keep the test to a suitable length for young children, only one example of a vowel was included. The nonsense forms employed in this study are given in Table 1.

A selection of eight real words, representing a variety of traditional phonological classes, was also included in the test. Words were selected with which young children might reasonably be expected to be familiar (Table 2).

TABLE 1

NONSENSE FORMS

Stem Class	Phonemic Representation	Orthographic Representation	Stem Class	Phonemic Representation	Orthographic Representation
/p/	/krowp/	krope	/n/	/lən/*	lun
/t/	/zuwt/	zoot	/ŋ/	/liŋ/	ling
/k/	/fik/	fick	/r/	/tor/*	tor
/f/	/hiyf/*	heaf	/w/	/pluw/	plue
/θ/	/peθ/	peth	/y/	/driy/	dree
/b/	/ləb/	lub	/s/	/tæs/*	tass
/d/	/nid/	nid	/z/	/driyz/	dreeze
/g/	/wəg/*	wug	/š/	/tayš/	tyshe
/v/	/miv/	miv	/ž/	/kæž/*	kazh
/ð/	/wowð/	wothe	/č/	/gəč/*	gutch
/l/	/brəl/	brull	/ǰ/	/luwǰ/*	loodge
/m/	/puwm/	poom	Vowel /a/	/gra/	grah

* Borrowed from Berko, 1958

TABLE 2

REAL WORDS

Phonological Class	Stem Class	Phonemic Representation	Orthographic Representation
Voiceless stop	/p/	/kəp/	cup
Voiced stop	/g/	/dag/	dog
Nasal	/n/	/pen/	pen
Liquid	/r/	/kar/	car
Fricative	/s/	/glæs/	glass
Affricate	/č/	/wič/	witch
Vowel	/a/	/s a /	saw
Semi-vowel	/w/	/šuw/	shoe

The final test consisted of 24 nonsense items and eight real words. These were put into random order by drawing numbers out of a hat. This order is shown in Table 3.

TABLE 3

TEST ITEM ORDER

1.	/glæs/	17.	/tayš/
2.	/hiyf/	18.	/pluw/
3.	/krowp/	19.	/zuwt/
4.	/gra/	20.	/nid/
5.	/liŋ/	21.	/dag/
6.	/lәb/	22.	/driy/
7.	/fik/	23.	/gәč/
8.	/šuw/	24.	/puwm/
9.	/wowð/	25.	/kæž/
10.	/tæs/	26.	/tor/
11.	/kәp/	27.	/kar/
12.	/peθ/	28.	/sa/
13.	/brәl/	29.	/pen/
14.	/miv/	30.	/wič/
15.	/luwǰ/	31.	/driyz/
16.	/lәn/	32.	/wәg/

Items were presented in two different orders, normal (1-32) and reverse (32-1). These orders appear to be inter-dependent, since any item always occurs between the same two other items. However, since the items are presented one by one, the two orders result in completely different environments, as a response can only be influenced by what has preceded it, not by what is to follow it.

E drew pictures representing the eight real words and invented imaginary animals for the 24 nonsense forms. The imaginary animals always differed in several important aspects from any real animal known to E. Younger children can be insistent and it was thought wise to provide clear evidence for picture "X" being, for example, not a "birdie" but a /wəg/. A sample picture is shown in Appendix 1.

Two identical pictures were drawn on two 8" x 5" cards, using brightly colored felt-tipped pens. The cards were numbered lightly in pencil so that the correct order could be maintained.

The illustrations proved to be interesting enough to hold the children's attention, as well as to illustrate the singular-plural distinction. Apart from a few sophisticated seven year olds, all the children enjoyed the pictures and frequently made unsolicited comments about them. The younger children almost always wanted to play the "game" again and again.

Subjects

Since previous studies have tested children only from

age four years and up, and have always found that even four year olds have productive control of plurals already established, it was decided to start with very young children, continuing through to eight years. In order to follow development as closely as possible, an age range of six months was set up for each group. Since children generally start speaking in "sentences" by age two, the first group was two to two and one-half years, the next was two and one-half to three years, and so on to the last group which was seven and one-half to eight years. To provide a balanced sample, 10 subjects were tested in each age group. Thus a total of 120 subjects was tested in all.

Subjects were a random sample of monolingual English speakers obtained from private homes, private and subsidized day care centers, and a public school. Berko found there was no significant difference between responses of boys and girls in the performance of a plurals test. No restriction was placed on the numbers of each sex in any grouping in this study.

Four two-year-old subjects had to be discarded on the grounds of inability or unwillingness to perform the task required of them. They were replaced by others of the same age.

Procedure

Subjects were all tested individually and by the same investigator, in a situation as isolated from people and other distractions as circumstances permitted. It was found

preferable to keep the mothers of the two year olds close by, but they were advised not to give the answers. E frequently played with the two to two and one-half year olds for a period of time until the child accepted her and reacted favorably to E's request "Would you like to look at some funny pictures?", or "Would you like to play a game with me?"

All subjects were given the following explanation of what E wanted them to do.

E: "I'm going to show you some funny pictures I made up, and I'll tell you their names. I want to see if you can say their names for me." (The first picture was then presented.)

E: "Look, this is (called) a /wəg/. Can you say that?"

S" "/wəg/" or "It's a /wəg/"

E: "Good! Oh, now here is another /wəg/", (putting the second card beside the first).

E: "Now what have I got? I've got two ... (voice trailing off expectantly).

E repeated the name in isolation, "/wəg/", if S appeared unsure of the name. Repetition of the singular stimulus form was insisted on to minimize perception errors (see Natalicio, 1969). Frequently the subjects responded before E had said all of her text - and often before the second card was produced - once the task had been practised

on a few items. Many children showed delight in anticipating what was going to happen.

When a subject mispronounced the stimulus word, E repeated it clearly until it was corrected or until she decided the child could not correct it. When the subject had responded with "two ....", E praised S by saying "good, fine, okay, or that's right" in the same encouraging tone of voice, and recorded the response phonetically.

Two children of the youngest group repeated the singular form but appeared unable to produce "two ...". Often they would point excitedly at the picture and say e.g., "/wəg/" and also "Two!" or "You've got two!", or "Yes, /wəg/!". Since it was unclear whether a plural meaning was intended in these cases, these Ss were discarded. One case of a two-year-old boy who always responded with "more /wəg/" was accepted into the subject sample, since, according to his mother, "more" was for him the regular plural marker.

The first intelligible response was accepted unless the S corrected himself spontaneously. Since the aim of the study was to discover what children are able to produce, self-corrections were accepted. For the same reasons, testing procedures had to be slightly varied for two year olds. Such young children become tired easily and want more variety. If an S wanted to stop and talk about the pictures (or anything else), E soon learned to allow this to ensure continued cooperation. The first principle in

handling two year old Ss was to "keep them happy"; they could be forced to sit and look, but not to give responses. Following this strategy, only two subjects had to be discarded because of an unwillingness (rather than inability) to participate.

CHAPTER THREE

RESULTS AND DISCUSSION

Scoring system

Ss' responses were coded 0-9 according to the following system:

0 correct - ending supplied according to the adult rule (p. 11)

1 irrelevant - employed when a S did not repeat the singular stimulus correctly

2 zero ending - no suffix added

3 incorrect /ðz/ ending

4 incorrect /s/ ending

5 incorrect /z/ ending

6 reduplication - /sðz/ or /zðz/ ending

9 bizarre - apparently random responses such as the pluralization of /gra/ as /graf/

Summary of results

Responses were tabulated according to the stem-final segment of each nonsense form (Table 4) and each real word (Table 5).

Rank order of difficulty

For initial tests, the scoring code was collapsed to a correct-incorrect system, where all values 1-9 were recoded

TABLE 4

FREQUENCIES OF RESPONSES TO NONSENSE FORMS

	Response Code							
Item	0	1	2	3	4	5	6	9
r	104	0	15	0	0	0	1	0
d	103	1	15	0	0	0	1	0
m	102	0	17	0	0	0	1	0
g	102	1	16	1	0	0	0	0
w	101	0	18	0	0	0	1	0
y	100	0	17	0	0	0	3	0
n	97	0	21	0	0	0	2	0
p	96	1	21	0	0	0	2	0
ŋ	96	0	22	0	0	0	2	0
b	95	0	24	0	0	0	1	0
k	92	1	23	0	0	0	4	0
l	92	2	24	0	0	0	2	0
t	91	1	27	0	0	0	1	0
a	90	2	25	0	0	0	2	1
v	85	5	23	4	0	0	3	0
f	79	3	29	7	0	0	1	1
ð	55	9	46	7	0	0	1	2
θ	49	12	44	13	0	1	0	1
č	42	0	74	0	4	0	0	0
š	38	4	70	0	8	0	0	0
ǰ	35	1	81	0	2	1	0	0
s	34	2	81	0	1	1	0	1
ž	34	12	73	0	1	0	0	0
z	18	0	102	0	0	0	0	0

TABLE 5

FREQUENCIES OF RESPONSES TO REAL WORDS

	Response Code							
Item	0	1	2	3	4	5	6	9
r	110	0	10	0	0	0	0	0
g	108	3	7	1	0	0	1	0
w	98	0	19	0	0	0	3	0
n	104	0	16	0	0	0	0	0
p	98	0	17	3	0	0	2	0
a	106	0	14	0	0	0	0	0
s	89	0	30	1	0	0	0	0
č	80	0	36	0	3	0	0	1

as 1 (incorrect). The stem-final segments of the nonsense forms were then ranked in order of difficulty on the basis of the total number of correct responses to each item (Table 6). It is noteworthy that there are three phonetically homogeneous groups in evidence here: the sibilants group together as the six most difficult items on the test; the remaining fricatives then group together as the next four most difficult items, leaving the non-fricatives as the easiest items.

Order and sex effects

The test items were presented to the Ss in two orders,

TABLE 6

RANK ORDER OF DIFFICULTY FOR NONSENSE FORMS

Rank	Item	Total Correct	% Correct
1	r	104	87
2	d	103	86
3.5	m	102	85
3.5	g	102	85
5	w	101	84
6	y	100	83
7	n	97	81
8.5	p	96	80
8.5	ŋ	96	80
10	b	95	79
11.5	k	92	77
11.5	l	92	77
13	t	91	76
14	a	90	75
15	v	85	71
16	f	79	66
17	ɣ	55	46
18	θ	49	41
19	č	42	35
20	š	38	32
21	ǰ	35	29
22.5	s	34	28
22.5	ž	34	28
24	z	18	15

normal and reverse. To test whether responses were influenced by a preceding item, the two sets of results were compared for each item. Two-tailed t-tests showed these differences to be non-significant ($\alpha > .01$) for all but two items. These were the nonsense stems in /g/ ($\alpha = 0.003$) and in /ǰ/ ($\alpha = 0.006$). It was noted, however, that the raw scores for the reverse order Ss were consistently higher than those for the normal order Ss. Since it would not be expected that a difference in the presentation order would affect all items in this unidirectional way, it was concluded that the two "order effects" noted were primarily due not to differences in the presentations, but rather to differences between the Ss who were assigned to these orders. A two-tailed t-test was also run to determine differences appearing as a function of the sex of the S. The difference between girls' and boys' performance was not significant on any item ($\alpha > .01$). On these bases, all of the data were pooled for the general analysis.

Comparisons with Berko study

The responses by Ss aged four to five and five and one-half to seven were compared with those for corresponding items in Berko's study (Table 7). It is not entirely clear whether any of Berko's Ss were in the age range five to five and one-half. At one point Berko says that her younger group "ranged between four and five years in age" (1958, p.153), but elsewhere she says that the oldest of these were already "five years old" (p.159). She states, however, that there

was a natural age break between the two groups, and on this basis the five to five and one-half age group in the present study was excluded from the comparisons.

It can be seen from Table 7 that the two sets of results show considerable agreement ($r = .964$ for the overall results). There is a clear division between sibilants and non-sibilants in both studies, the lowest score for the non-sibilants being 74% (Innes) and 79% (Berko), and the highest score for the sibilants being 48% (Innes) and 36% (Berko). Berko's results also show the expected improvement in performance by the older group. In the present study there are a few unexpectedly higher scores in the younger group. This point is discussed further, later on in this chapter. In general, however, we may say that the present study constitutes a satisfactory replication and extension of Berko's original work and that new data introduced here may reasonably be considered in evaluating some of Berko's general hypotheses and conclusions.

Real words in both studies were pluralized correctly by more Ss than their corresponding nonsense forms. Berko had only one real word, glass, which 91% of her Ss pluralized correctly, whereas only 36% pluralized the nonsense word /tæs/ correctly. This is the basis for Berko's contention that children learn a pluralization rule rather than merely memorize long lists of individual plural forms. Similar results were obtained in the present study. Ss' responses to identical final segments in real words and

TABLE 7

COMPARISON OF BERKO'S RESULTS

WITH CORRESPONDING ITEMS IN THE PRESENT STUDY

	% Correct Groups A & B		% Correct Group A *		% Correct Group B **	
Item	Berko	Innes	Berko	Innes	Berko	Innes
r	85	88	73	85	90	90
g	91	86	76	75	97	93
n	86	86	68	80	92	90
a	79	76	58	70	86	80
f	82	74	79	75	80	73
č	36	48	28	55	38	43
s	36	34	28	45	39	27
ž	31	38	25	30	36	43
z	28	16	14	15	33	17
glass	91	82	75	75	99	87

* Age Group A = 4-5 years ** Age Group B = 5 1/2 - 7 years

nonsense forms are compared for the present study in Table 8. Many more correct responses were recorded for the real words with final segments /s/ and /č/ than for the corresponding nonsense words. This means that, in the case of /č/, for example, about half the Ss who responded

TABLE 8

TOTAL CORRECT RESPONSES FOR REAL WORDS AND CORRESPONDING NONSENSE FORMS IN THE PRESENT STUDY

Final Segment	Real Word		Nonsense Form	
r	110	(92%)	104	(87%)
g	108	(90%)	102	(85%)
w	98	(82%)	101	(84%)
ŋ	104	(87%)	97	(81%)
p	98	(82%)	96	(80%)
a	106	(98%)	90	(75%)
č	80	(67%)	42	(35%)
s	89	(74%)	34	(48%)

correctly to the real word were imitating a remembered model, but the other half, who also responded correctly to the nonsense form, could have been employing some sort of rule. Where there were more than 75% correct responses to a nonsense form, Ss, were considered to have achieved mastery in the productive pluralization of the stem class in question, and no further analysis was carried out on this item.

Berko noted that the phonotactics of English prohibit /z/ after voiceless obstruents and /s/ after voiced ones, but with no such restriction after the resonant consonants and

vowels (cf. else (= /els/) vs. ells (= /elz/)). In Berko's study, /n/, /r/ and /a/ represent this group. Berko suggests that these items may be expected to be harder for children to pluralize than items in non-sibilant obstruents, such as /g/, where the choice between /z/ and /s/ is phonotactically determined. In the present study all of the consonants of this group, /l/, /r/, /m/, /n/, /ŋ/, /w/ and /y/, were tested, and also the vowel /a/. Reference to Table 6 shows that Ss did not have particular difficulty with any of these forms; in fact, /r/ was the easiest item and the other five are scattered through the list. It appears, then, that Berko's hypothesis is not borne out in this case. It is interesting that in the Berko study no Ss gave an /s/ suffix where /z/ was correct, or vice versa. In the present study this applies to the non-fricatives, but there was one example of a /z/ suffix being applied to /θ/.

Berko reported that some Ss pluralized stems in /č/ and /ž/ by adding /s/ (10% and 5% respectively). The corresponding percentages in the present study were lower (3% and 1%), though 7% of the Ss pluralized /š/ in this way, and 2% /ǰ/. Clearly, this tendency is manifested by a relatively small proportion of Ss in both studies.

Factor analysis

A factor analysis was performed on the nonsense data. Correlation tests carried out on the 24 items showed all correlations between them to be positive or near zero. There were four Eigenvalues over one, but it was decided to adopt

the three-factor solution, since the fourth factor had a value very close to one, and the four-factor solution was not readily interpretable. A simple structure solution showed that the strongest factor was represented by the non-sibilant segments, less /f/, /θ/ and /ð/. The second factor consisted of the sibilants, while the segments /f/, /θ/ and /ð/ formed the third factor. The three factors together accounted for 62% of the total variance (Table 9). With only one exception these factors are readily interpreted in terms of the traditional groupings of non-fricatives, sibilants, and non-sibilant fricatives. One would expect the third factor to include /v/, the voiced counterpart of /f/, and for the first factor to exclude /v/, but the factor analysis does not support this. The total number and percentage of incorrect responses were also tabulated for each of these factors (Table 10). These data indicate that the nonsense forms group together into three main groups from the standpoint of behavior under pluralization. The first of these is the largest, containing all of the stem classes except those in a final sibilant or in a final /f,θ,ð/; these nonsense forms are all pluralized very easily by most Ss. The second group contains the sibilant stems, whose plurals present serious problems to most children. The plurals of the third group, finally, whose stems end in /f/ or one of the interdental fricatives, are of intermediate difficulty. Both the factor analysis and the rank order

TABLE 9

FACTORS OPERATING ON THE DATA

	Factors	% of Total Variance Accounted For
1.	Non-sibilants except /f/, /θ/, /ð/	37
2.	Sibilants	15
3.	/f/, /θ/, /ð/	10
	TOTAL	62

TABLE 10

TOTAL ERRORS AND PERCENT ERROR

ON ITEMS INCLUDED WITHIN EACH FACTOR

Factor	Total Errors	% Error
1	319	18
2	519	72
3	183	51

data thus suggest that children learn to expand their tentative pluralization rule not on a simple item-by-item basis, but rather by the successive incorporation of entire classes of items. These classes need not necessarily correspond to the correct, adult classes, however. As can be seen from Table 4, for example, all four of the non-sibilant fricative stems (i.e., stems ending in a /θ/, /ð/, /f/ or /v/) uniquely share the common error pattern of the /əz/ suffix. This suggests that children first overgeneralize the /əz/ ending to apply to all of the fricatives as a class before separating out the sibilants as the appropriate subclass.

Age

Analysis of the data in terms of the original six-month age categories proved completely unsatisfactory from the standpoint of revealing any interesting developmental trends. Ss were thus regrouped into six age categories on a full year basis and total correct responses were tabulated for each of these groups (Figure 1).

Figure 1. Percentage correct responses for each age group.

As can be seen from the graph, the number of correct responses increases quite dramatically from age two to three, from three to four, and from five to six, but levels off between the ages of four and five and between six and seven.

The scores for each of the nonsense forms were next examined for each age group (Table 11). It is noteworthy that although this table reveals a fairly consistent developmental trend for some of the easier items, the picture for the lower-ranked items is extremely chaotic. In particular, the five year olds have surprisingly low scores and the four year olds surprisingly high scores on all of these items. A correlation of .414 was obtained between age and overall performance on the nonsense items. This indicates that age was a relatively poor indicator of performance in this study, and that some other basis would have to be found for grouping the Ss if any developmental trends were to be identified.

Performance groups

Since there was no valid external criterion available for grouping the Ss, it appeared that overall performance on the nonsense items provided the best available measure of relative linguistic maturity. The subject sample was thus partitioned into 25 blocks on the basis of the total number of correct responses to the nonsense forms (zero correct, one correct, two correct, etc.). For purposes of comparison with the age-based analysis, these blocks were then collapsed into six "performance groups" containing approximately the same number of Ss (Table 12).

TABLE 11

PERCENTAGE OF CORRECT RESPONSES

FOR EACH AGE GROUP ON THE NONSENSE FORMS

	Age in Years					
Item	2	3	4	5	6	7
r	70	80	85	95	90	100
d	65	65	90	95	100	100
m	55	80	85	95	95	100
g	70	75	75	95	95	100
w	70	75	90	95	80	95
y	70	80	80	100	90	80
n	60	70	80	95	90	90
p	55	80	85	80	90	90
ŋ	60	75	80	85	90	90
b	60	70	75	80	95	95
k	50	85	70	75	90	90
l	45	65	85	85	90	90
t	50	75	75	85	95	75
a	60	70	70	75	90	85
v	30	70	65	80	90	90
f	45	45	75	55	85	90
ð	30	40	50	40	55	60
θ	10	25	35	40	55	80
č	25	15	55	20	55	40
š	20	25	45	25	40	35
ǰ	10	25	45	20	40	35
s	20	25	45	10	40	30
ž	15	15	30	15	55	40
z	5	10	15	5	20	35

TABLE 12

COMPOSITION OF THE PERFORMANCE GROUPS

Performance Group	Total Correct Responses	Number of Subjects
I	0- 7	19
II	8-14	17
III	15-16	22
IV	17-18	23
V	19-21	21
VI	22-24	18

The percentage of correct responses on each item was then tabulated for each group (Table 13). This table presents a much more systematic picture of development than the age-based analysis of Table 11. The relationship between Ss' age and performance groups is shown graphically in Figure 2. If a criterion of 75% is used to indicate mastery of an item, Table 13 reveals a developmental pattern which is characterized by two highly interesting features. First, the pattern is strictly hierarchical in character. That is, once a given item is mastered by one group, it continues to be mastered by all successive groups. Second, those new classes of items which are added by the more advanced performance groups correspond, by and large, to traditional phonological groupings. Group II, for example,

TABLE 13

PERCENTAGE CORRECT RESPONSES FOR THE PERFORMANCE GROUPS

	Performance Groups					
	I	II	III	IV	V	VI
Item	0-7	8-14	15-16	17-18	19-21	22-24
r	21	94	100	100	100	100
d	21	94	95	100	100	100
m	21	82	100	100	100	100
g	37	86	100	100	95	100
w	11	100	100	91	100	100
y	26	94	95	86	95	100
n	5	76	95	100	100	100
p	21	65	95	100	100	100
ŋ	11	65	95	100	100	100
b	16	59	100	100	90	100
k	11	59	91	91	100	100
l	5	86	82	96	100	100
t	16	59	82	96	100	94
a	5	57	91	96	100	100
v	11	57	73	96	95	94
f	16	29	65	83	95	100
ð	21	35	14	61	62	83
θ	16	0	28	52	62	83
č	5	3	14	26	71	89
š	5	0	14	22	57	94
ǰ	5	0	9	26	52	83
s	5	0	9	17	62	78
ž	0	3	9	13	48	100
z	0	6	0	4	14	66

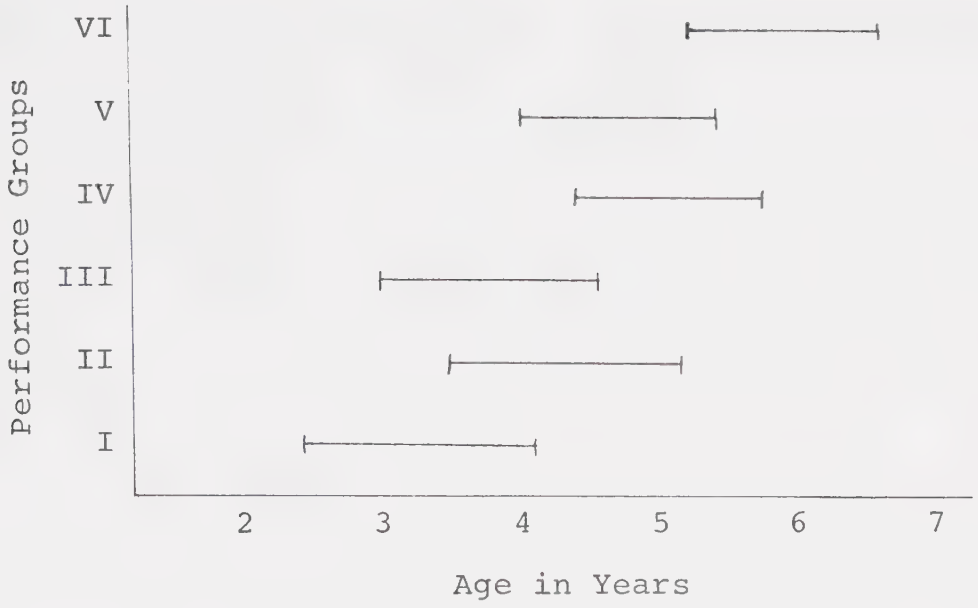

Figure 2. Age range for performance groups I-VI with 95% confidence interval around the mean.

indicates mastery of all the non-fricative stems, Group IV adds the labio-dental fricatives, /f/, and /v/, and Group VI adds all of the remaining fricatives and affricates except /z/. Group I does not show mastery of any of the items, while Group V does not stand out as a separate stage under the 75% criterion. Group II is the most anomalous, however, with Ss meeting the criterion on items 1-6 and 12, while failing to meet it on other items which seem to group naturally with these from the standpoint of phonetic similarity.

The natural break in scores which occurs in the range of 30% to 50% for Groups II through VI provides strong evidence in favour of selecting the modal response to each item as the representative response for each group. For every group there is a difference of from 22% to 37% between the lowest correct majority response (50% or higher) and the highest correct non-majority response. However, the

considerable improvement from group to group which appears with many of the majority responses cannot be ignored. The scores on several items increase by 30% and more between Group II and Group III, for example. Indeed, it appears that about half of the items are learned in three stages, the progression being from a score well below 50% to one of 48-75%, and then to one of 80-100%.

Nonetheless, analysis in terms of modal responses seems to reveal the most interesting and systematic developmental pattern for the acquisition of the English pluralization rule (Table 14). This table retains all of the important features of Table 13, while also removing some of the anomalies. For one thing, all six of the performance groups now stand out as potentially distinct developmental stages. Moreover, the new classes of items which are added by each successive group coincide almost perfectly with traditional phonological classes. Group I Ss fail to provide correct plurals for any of the nonsense stems; these Ss are presumably still at the mimicry stage and have not yet learned to extract any rules for pluralization. Group II Ss exhibit control of all of the first fifteen items, namely, the non-fricatives plus /v/, while Group III Ss add to these the one new item, /f/. Group IV Ss next add the interdental fricatives, /θ/ and /ð/, Group V all of the sibilants except /z/, and Group VI, finally, add the last sibilant, /z/.

TABLE 14

MODAL RESPONSES FOR PERFORMANCE GROUPS

		Performance Groups					
Rank	Item	I	II	III	IV	V	VI
1	r	ϕ	z	z	z	z	z
2	d	ϕ	z	z	z	z	z
3.5	m	ϕ	z	z	z	z	z
3.5	g	ϕ	z	z	z	z	z
5	w	ϕ	z	z	z	z	z
6	y	ϕ	z	z	z	z	z
7	n	ϕ	z	z	z	z	z
8.5	p	ϕ	s	s	s	s	s
8.5	ŋ	ϕ	z	z	z	z	z
10	b	ϕ	z	z	z	z	z
11.5	k	ϕ	s	s	s	s	s
11.5	l	ϕ	z	z	z	z	z
13	t	ϕ	s	s	s	s	s
14	a	ϕ	z	z	z	z	z
15	v	ϕ	z	z	z	z	z
16	f	ϕ	ϕ	s	s	s	s
17	ɣ	ϕ	ϕ	ϕ	z	z	z
18	θ	ϕ	ϕ	ϕ	s	s	s
19	č	ϕ	ϕ	ϕ	ϕ	∂z	∂z
20	š	ϕ	ϕ	ϕ	ϕ	∂z	∂z
21	ǰ	ϕ	ϕ	ϕ	ϕ	∂z	∂z
22.5	s	ϕ	ϕ	ϕ	ϕ	∂z	∂z
22.5	ž	ϕ	ϕ	ϕ	ϕ	ϕ /∂z	∂z
24	z	ϕ	ϕ	ϕ	ϕ	ϕ	∂z

Note: All responses except ϕ are correct.

Pluralization rules

Examination of the data in terms of both the 75% "mastery" criterion and the modal response provides further evidence that the English pluralization rule is not built up on an item-by-item basis, but rather on a class-by-class or feature basis. If we take the six performance groups to represent six distinct stages in the development of the rule, and if we take the modal response as the representative response for each group, we can formulate a set of tentative rules which describe the productive pluralization behavior of children at each stage.

Stage I: No overt plural markers used with unfamiliar words. Schematically,

$$(\text{Pl}) \rightarrow \phi .$$

Stage II: The suffix /s/ is added to voiceless non-fricative consonantal stems and the suffix /z/ to vowel stems, to voiced non-fricative consonantal stems and to stems in final /v/. No overt plural marker is used with any other unfamiliar words. Schematically,

$$(\text{Pl}) \rightarrow \left\{ \begin{array}{ll} \underline{s} \,/ & \begin{bmatrix} C \\ -\text{fricative} \\ -\text{voiced} \end{bmatrix} \quad \_\_ \\ \underline{z} \,/ & \left\{ \begin{array}{c} V \\ \begin{bmatrix} C \\ -\text{fricative} \\ +\text{voiced} \end{bmatrix} \\ \underline{v} \end{array} \right\} \quad \_\_ \\ \phi & \text{elsewhere} \end{array} \right\}$$

Stage III: The suffix /s/ is added to voiceless non-fricative consonantal stems and to stems in final /f/ and the suffix /z/ is added to vowel stems, to voiced non-fricative consonantal stems and to stems in final /v/. No overt plural marker is used with any other unfamiliar words. Schematically,

$$(\text{Pl}) \rightarrow \left\{ \begin{array}{lll} \underline{s} / & \left\{ \begin{array}{c} C \\ \left[\begin{array}{l}\text{-voiced} \\ \text{-fricative}\end{array}\right] \\ \underline{f} \end{array} \right\} & \_\_ \\ \underline{z} / & \left\{ \begin{array}{c} V \\ C \\ \left[\begin{array}{l}\text{+voiced} \\ \text{-fricative}\end{array}\right] \\ \underline{v} \end{array} \right\} & \_\_ \\ \phi & \text{elsewhere} & \end{array} \right\}$$

Stage IV: The suffix /s/ is added to voiceless, non-sibilant consonantal stems and the suffix /z/ to vowel stems and to voiced, non-sibilant consonantal stems. No overt plural marker is used with any other unfamiliar words. Schematically,

$$(\text{Pl}) \rightarrow \left\{ \begin{array}{lll} \underline{s} / & \left[\begin{array}{l} C \\ \text{-voiced} \\ \text{-sibilant}\end{array}\right] & \_\_ \\ \underline{z} / & \left\{ \begin{array}{c} V \\ C \\ \left[\begin{array}{l}\text{+voiced} \\ \text{-sibilant}\end{array}\right] \end{array} \right\} & \_\_ \\ \phi & \text{elsewhere} & \end{array} \right\}$$

Stage V: The suffix /s/ is added to voiceless, non-sibilant consonantal stems, the suffix /z/ to vowel stems and to voiced, non-sibilant consonantal stems, and the suffix /ə z/ to all sibilant stems except stems in final /z/. No overt plural marker is used with unfamiliar stems in final /z/. Schematically,

$$(P1) \rightarrow \left\{ \begin{array}{lll} \underline{s} / & \begin{bmatrix} C \\ -\text{voiced} \\ -\text{sibilant} \end{bmatrix} & \_\_ \\ \underline{z} / & \left\{ \begin{bmatrix} V \\ C \\ +\text{voiced} \\ -\text{sibilant} \end{bmatrix} \right\} & \_\_ \\ \text{ə}z/ & \begin{bmatrix} C \\ +\text{sibilant} \\ (\text{except } \underline{z}) \end{bmatrix} & \_\_ \\ \phi \ / & \underline{z} & \_\_ \end{array} \right\}$$

Stage VI: The suffix /s/ is added to voiceless, non-sibilant consonantal stems, the suffix /z/ to vowel stems and to voiced, non-sibilant consonantal stems, and the suffix /əz/ to sibilant stems. Schematically,

$$(P1) \rightarrow \left\{ \begin{array}{lll} \underline{s} / & \begin{bmatrix} C \\ -\text{voiced} \\ -\text{sibilant} \end{bmatrix} & \_\_ \\ \underline{z} / & \left\{ \begin{bmatrix} V \\ C \\ +\text{voiced} \\ -\text{sibilant} \end{bmatrix} \right\} & \_\_ \\ \underline{\text{ə}z} / & \begin{bmatrix} C \\ +\text{sibilant} \end{bmatrix} & \_\_ \end{array} \right\}$$

The reason why these particular sub-classes were relevant for Ss was not investigated, but some suggestions may be made. Stage VI matches adult competence (cf. p. 11 above). Stage V deviates only in the case of /z/, where the majority of Ss added no suffix. A likely explanation hinges on the fact that the item in question already sounds like the plural. (Note that this is not true of the /s/ allomorph; compare /driyz/ and /driys/.) At Stage IV, none of the sibilant items has an overt plural marker, while all the non-sibilant stems are pluralized correctly. There is no obvious explanation for this, but it is likely that frequency considerations may play a role. At Stage III the interdental fricatives, /θ/ and /ð/ are treated like the sibilants (null ending). The fact that /f/ is also included in this group at Stage II suggests that the quality of being fricative might at first be identified as the relevant property of the class, which is only later refined to the sibilant sub-class. The fact that /v/ groups with the non-fricatives is inexplicable in these terms, yet the results of the factor analysis support this division (p. 29).

Implications for further research

This study provides an essential complement to Berko's fragmentary data. There is, however, a need for replication to confirm its results. The experience gained in carrying out the testing and analysis of results should lead to some improvements in replications and further similar investigations.

As already noted, it seems that the relative frequency

of the various stem-final segments in children's experience may provide an explanation for at least some of the results obtained. One useful adjunct to this study might be to examine this factor by means of the available word lists.

In future studies it would be advisable to have the data scored by more than one examiner, in order to provide some reliability measure for the scoring system. This may be achieved by recording all responses or by having more than one examiner present during the testing.

Since age was not a very useful measure of performance in this study, Ss' results were analyzed in terms of performance groups on a purely ad hoc basis internal to the study. An attempt should be made to relate these groups to some independent measure of mental age such as a standard IQ test or a cognitive concept test.

The effects of other variables on the results might be considered, as well. Background information might usefully be gathered on each S, such as information about the parents' educational and socio-economic level and the number and ages of siblings. Such data might help account for individual low or high scores where a simple IQ measure was insufficient.

In subsequent studies some attempt should also be made to vary the non-final segments to see if the results are compatible. Natalicio's results (see p.4) suggest that there would be no effect with words of the same canonical form, CVC. It seems likely, however, that the more complex canonical forms involving consonant clusters would

significantly affect performance.

More care should also be taken in selecting real words for test items. It would be helpful to consult word frequency lists for the appropriate age group. In particular, words which children prefer to use in a different form should be avoided; in this study many Ss wanted to change "dog" to "doggy", for example. The use of two similar sounding nonsense forms should also be avoided. In the present study the item /driyz/ sounded like the plural of another item /driy/; fortunately, the test for order effect indicated that this did not significantly affect Ss' performance on these two items.

This line of enquiry, initiated by Berko and more fully developed and refined in the present study, is evidently yielding useful results and should be continued. Berko's technique is one of the few available for the empirical investigation of rule learning, and the extension of this approach to a more thorough study of all the English inflections may well yield new data to clarify our understanding of how rule learning develops and what factors are primarily responsible for it.

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APPENDIX I

Sample picture to illustrate nonsense word

ITEM 23 - gutch